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AUTHOR	O'Bryan, Robert C.
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ABSTRACT

Designed to provide instructional materials for use by vocational agriculture teachers, this unit on breeding livestock contains materials for use in teaching the importance of breeding, the physiology of livestock breeding, reproductive processes, sire selection, and breeding systems. Lessons on each of these competencies contain the following: (1) a performance objective, (2) teaching-learning activities, (3) supplemental materials, and (4) a criterion-referenced measure. Suggestions for using problem-solving procedures, resource persons, field trips, audio-visual aids, and supplementary materials are outlined in the section on teaching-learning activities provided for each lesson. Transparency masters of charts, tables, and illustrations are provided in each lesson. (Related documents contain similar instructional materials on dairy housing and equipment, feeding livestock, livestock judging, tobacco production, and corn production--see note.) (MN)

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BREEDING LIVESTOCK

A Unit for Teachers of Vocational Agriculture

Developed by:

Robert C. O'Bryan
Teacher of Vocational Agriculture
Johnson Central High School
Paintsville, Kentucky

Supervised by:

Rodney W. Tulloch
Associate Professor and Project Director
University of Kentucky

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BREEDING LIVESTOCK

Number of Class Periods _____ Month(s) _____

INTRODUCTION

Breeding livestock is one of the most important activities of a successful livestock producer. A breeder must have a knowledge of the characteristics of livestock that are desirable and those that are not desirable. A livestock breeder should understand the importance of breeding so as to take advantage of characteristics which are passed on to offspring with great consistency. The breeder of livestock must also be aware of variations which may be produced through breeding and use these to advantage in the breeding program.

Lessons found in this unit are as follows:

1. Importance of Breeding
2. Physiology of Livestock Breeding
3. Reproductive Process
4. Sire Selection
5. Breeding Systems

DIRECTIONS

Each competency listed is followed by: (1) a performance objective, (2) teaching-learning activities, (3) supplemental materials, and (4) a criterion referenced measure. Since all of these competencies are necessary for successful breeding of farm animals, all should be taught unless previous learnings would cause this to be unnecessary. The competencies do not have to be taught in the order in which they are listed; however, they are listed in a logical order.

1. IMPORTANCE OF BREEDING

1.1 Performance Objective

Given a written check-out activity concerning the importance of breeding, students will complete the activity with 80 percent accuracy.

1.2 Teaching-Learning Activities

a. This section on the importance of breeding can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Take the students on a field trip to a nearby farm where good breeding practices and the results of good breeding can be observed and discussed.

c. Use a good livestock breeder, extension personnel, or breed association personnel as resource persons.

d. Make and use transparencies and/or handouts from the transparency masters found under Supplementary Materials.

1.2.1 Identify the factors that influence the ability of farm animals to reproduce.

a. Heredity. (See transparency master 1.2.1a.)

b. Environment. (See transparency master 1.2.1b.)

1.2.2 Recognize the influence of heredity and environment on growth, development, and production of farm animals.

a. When an animal is conceived, it possesses certain inherent characteristics which remain with it throughout its life. The inherent capacities of an animal which are present in the fertilized egg cannot be changed. However, within pure breeds of beef cattle which are managed under average or better conditions, only about 1/3 to less than 1/2 of the variation can be attributed to differences in heredity. In other words, environment is also very important. The crossing of breeds often produces better characteristics that the average from each breed of animals. Good purebred foundation stock is very important in developing a good breeding program.

b. After fertilization, the embryo becomes and continues to be subjected to and influenced by its environment, first in the body of the female and then after birth.

After birth, the influence of environment is greatly intensified. Environmental conditions can suppress or can bring out the inherited capacity of an animal to produce.

1.3 Supplementary Materials

References: See books listed under List of Resources at back of unit.

Transparency Masters: 1. 1.2.1a, "Heredity."

2. 1.2.1b, "Environment."

1.4 Check-Out Activities

Provide the students with the following exercise:

1. What are the factors that influence the capacity of farm animals to produce?

2. Inherent characteristics are passed at conception and cannot be changed during the lifetime of the animal. T F

3. Environment does not influence the embryo. T F

4. Inherent characteristics will fully develop regardless of the environment. T F

5. In well-managed beef animals as little as 1/3 of variation in growth may be due to differences in heredity. T F

ANSWERS:

1. Heredity, environment
2. True
3. False
4. False
5. True

HEREDITY

PASSED AT TIME OF FERTILIZATION AND CANNOT BE CHANGED

ENVIRONMENT

CAN SURPRESS OR BRING OUT THE INHERITED POTENTIAL

ENVIRONMENTAL FACTORS

WEATHER, NUTRITION, SANITATION, HOUSING, ETC.

2. PHYSIOLOGY OF LIVESTOCK BREEDING

2.1 Performance Objective

Given a written check-out activity concerning the physiology of livestock breeding, the student will complete the activity with 80 percent accuracy.

2.2 Teaching-Learning Activities

a. This section on the physiology of livestock breeding can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Take a field trip to a slaughter house or bring the reproductive tract of a female animal to the school.

c. Use a veterinarian or artificial inseminator as a resource person.

d. Make and use transparencies and/or handouts from the transparency masters.

2.2.1 Describe the reproductive role of the male and identify the parts of the male reproductive system.

a. Reproductive role of the male (♂):

(1) The production of live, healthy, reproductive cells (sperm). (See transparency masters 2.2.1a, 2.2.1b, and 2.2.1c.)
(2) The introduction of sperm cells into the female reproductive tract at proper time (when natural breeding is used).

b. Male reproductive system: (See transparency master 2.2.1d.)

(1) Scrotum - contains the testes. Helps maintain the temperature of the testes at about five degrees below normal body heat in order to prevent sterility.
(2) Testes - produces the male sperm cells and testosterone, the male sex hormone.
(3) Epididymis - long, greatly coiled tube which connects to each testis. It functions in storage, maturation, and transportation of sperm cells.
(4) Vas deferens (sperm duct) - elongated tube which connects epididymis with the urethra. Its function is transportation of sperm cells to the urethra.
(5) Spermatic cord - consists of vas deferens, smooth muscle, blood vessels and nerves. It is enclosed in a protective, fibrous sheath.

(6) Seminal vesicles - paired accessory glands which secrete seminal fluid into the urethra at the colliculus seminalis. The fluid functions in protection and as a transportation medium for sperm.
(7) Prostate gland - found near the urethra and the bladder. It produces a fluid which is mixed with the seminal fluid.
(8) Cowper's gland - secretes a fluid similar to seminal fluid. It is secreted before ejaculation, and its purpose is to neutralize and cleanse the urethra.
(9) Urethra - a tube extending from the bladder to the end of the penis. It functions as the transportation route for the semen and for urine.
(10) Semen - term given to the sperm plus the added accessory fluids (seminal and prostate fluids).
(11) Penis - external organ which deposits sperm cells within the female reproductive tract. In animals with a fibroelastic penis, a signoid flexure allows the penis to be extended for copulation. Animals with a vascular penis have no such structure. The retractor penis returns the penis into the sheath after mating.

2.2.2 Describe the reproductive role of the female and identify the parts of the female reproductive system.

a. Reproductive role of the female (♀):

(1) Produce female reproductive cell (egg). (See transparency master 2.2.1e.)
(2) Development of the embryo(s) inside the female's body.
(3) After development to give birth to new animals.
(4) Care of newborn for several weeks after birth.

b. Female reproductive system: (See transparency masters 2.2.1f and 2.2.1g.)

(1) Ovaries - two organs near the posterior end of the reproductive tract. The ovaries contain many follicles in which eggs are produced. They secrete the female sex hormones estrogen and progesterone and form the corpara lutea (plural of corpus luteum).
(2) Oviducts (fallopian tubes) - two tubes that carry eggs from the ovaries to the horns of the uterus. They lie close, but are not attached to the ovaries. The funnel-shaped end of each oviduct near the ovary is called infundibulum.
(3) Uterus (womb) - an organ with two horns (branches) that are connected to the oviducts. Fetal development occurs here. The male semen is deposited either in the posterior uterus or midcervix regions.
(4) Cervix - neck of the uterus. Separates the uterus from the vagina, acting as a valve.
(5) Vagina - a passage way between the cervix and vulva. The vagina expands to pass the fetus at birth.
(6) Urethra - carries urine from bladder to vagina.

(7) Clitoris - sensory and erectile organ of the female located just inside the vulva.
(8) Vulva - the external opening of the reproductive and urinary tracts.

2.2.3 Determine the average age farm animals reach sexual maturity.

a. Mare --- 10 to 12 months

b. Cow --- 8 to 12 months

c. Ewe --- 4 to 8 months

d. Sow --- 5 to 7 months

2.2.4 Compare the estrus cycle of female farm animals. (See transparency master 2.2.1h.)

Species	Length of Estrus Cycle (Days)		Length of Estrus	
	Average	Range	Average	Range
Mare	21	10-37	5-6 days	1-14 days
Cow	19-21	16-24	16-20 hrs.	8-30 hrs.
Ewe	16	14-20	30 hrs.	20-42 hrs.
Sow	21	18-24	1-5 days	1-5 days

2.2.5 Explain the fertilization process. (See transparency masters 2.2.1i and 2.2.1j.)

Fertilization is the union of the sperm and the egg. In the process of natural mating or artificial insemination, the semen containing the sperm is deposited within the vagina of the female. The sperm cells ascend the reproductive tract through the cervix, uterus, and into the oviducts. If the sperm cells are deposited at the proper time in relation to ovulation, a sperm will unite with an egg in the upper part of the oviduct. (In cattle, sperm live only 24 to 30 hours in the female reproductive tract and the unfertilized egg will live approximately 12 hours.)

The fertilized egg passes down the oviduct into the uterus. The embryo becomes attached to the mucous membrane of the uterus where it receives nourishment and is protected until fully developed. If no sperm unites with the egg, the female does not conceive, the egg cells are absorbed by the body, and the period recurs.

2.3 Supplementary Materials

References: See books listed under List of Resources at back of unit.

Filmstrips: 1. "Anatomy of the Fowl."

2. "Beef Cattle Castration."

3. "Sheep Castration."

Transparency Masters:

1. 2.2.1a, "Anatomy of Sperm."
2. 2.2.1b, "Species Differences in Sperm Anatomy."
3. 2.2.1c, "Semen Volume and Numbers for Farm Animal Species."
4. 2.2.1d, "Male Reproductive System."
5. 2.2.1e, "Anatomy of the Egg and Sperm."
6. 2.2.1f, "Female Reproductive System."
7. 2.2.1g, "Female Reproductive Tract."
8. 2.2.1h, "The Reproduction Cycle in Farm Animals."
9. 2.2.1i, "Ovulation."
10. 2.2.1j, "Fertilization in Cattle."

2.4 Check-Out Activities

Provide the students with the following exercise:

1. A most important part of the reproductive role of a male is to produce live, healthy sperm. T F
2. The organ(s) in the male that produce sperm is/are called _____.
3. _____ is term given to sperm plus the added accessory fluids.
4. Oviducts carry eggs from the ovaries to the horns of the uterus. T F
5. The vas deferens runs from the bladder to the end of the penis. T F
6. The uterus is sometimes called the womb. T F
7. The cervix is the neck of the vagina. T F
8. The vulva produces the eggs. T F

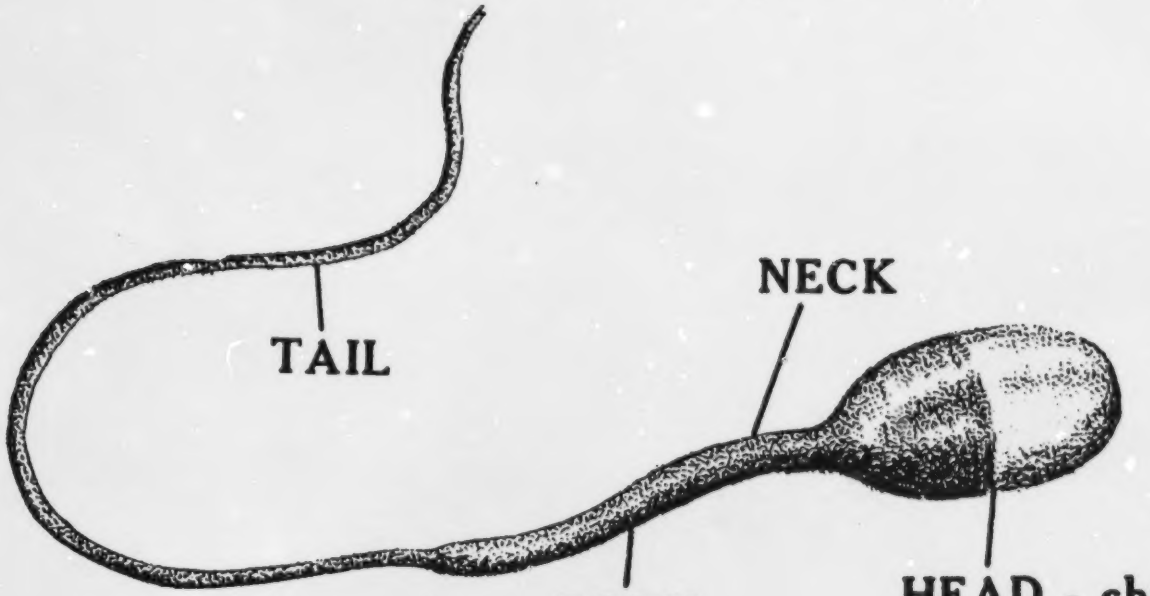
9. The average age of sexual maturity for a cow and sow are _ _____ and _____.

10. The average days estrus cycle for cows and sows are _____ and _____.

ANSWERS:

1. True
2. Testes
3. Semen
4. True
5. False
6. True
7. False
8. False
9. a. 8-12 months
   b. 5-7 months
10. a. 19-21
    b. 21

ANATOMY OF SPERM



TM 2.2.1a

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

SPECIES DIFFERENCES IN SPERM ANATOMY

BULL SHEEP CHICKEN RAT GUINEA PIG

TM 2.2.1b

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

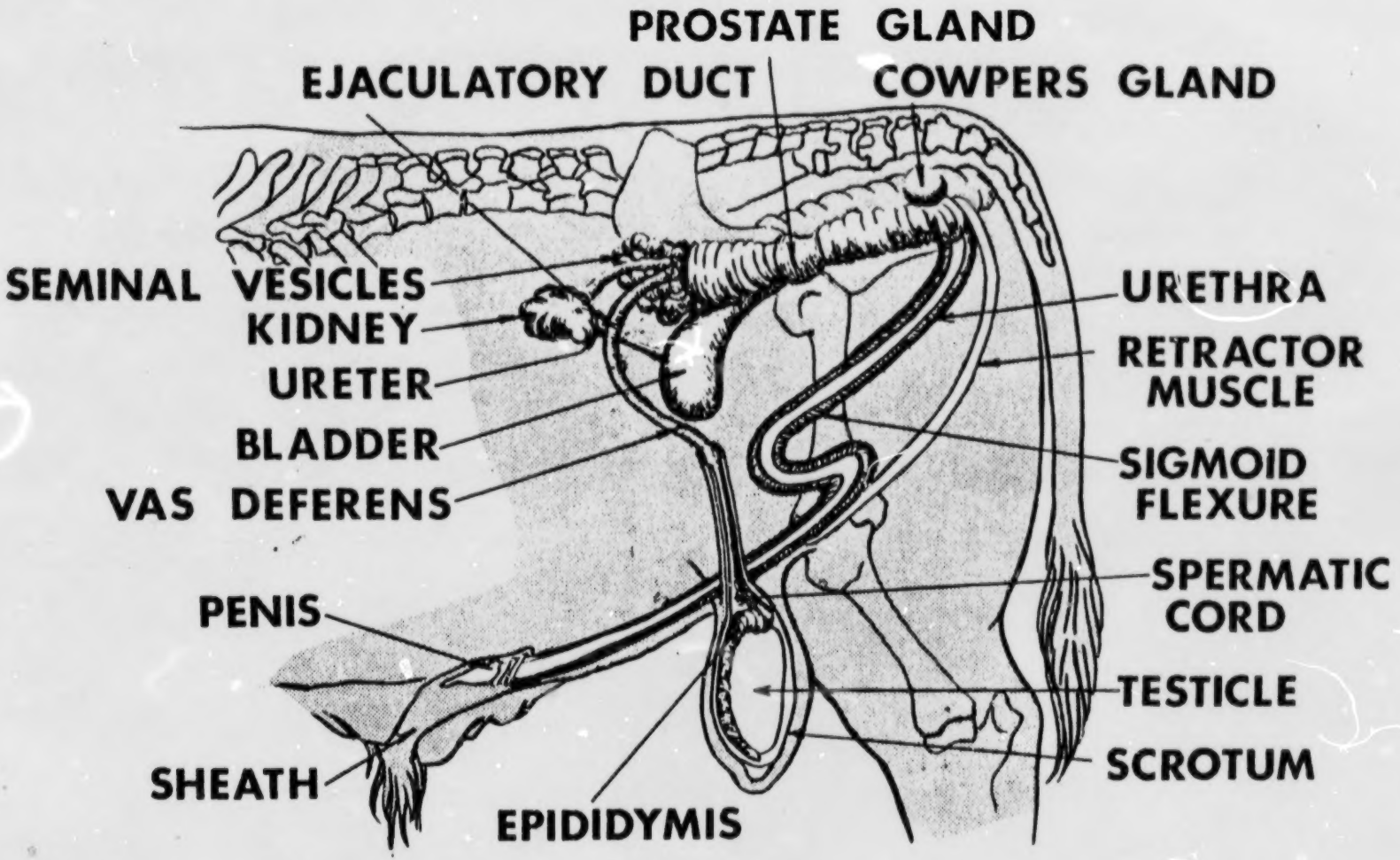
SEMEN VOLUME & NUMBERS FOR FARM ANIMAL SPECIES

Animal	Vol. per Ejaculate (ml.)	Sperm per mm. (1,000's)	Total Sperm per Ejaculate (billions)	No. Females Bred per Ejaculate
boar	150-250	100	15-25	10-12
bull		1,000	3-5	100-600
rooster	0.6-0.8	3,000	1.8-2.4	
ram	0.8-1.0	1,000	0.8-1.0	40-100
stallion	70-100	100	7-10	8-12

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

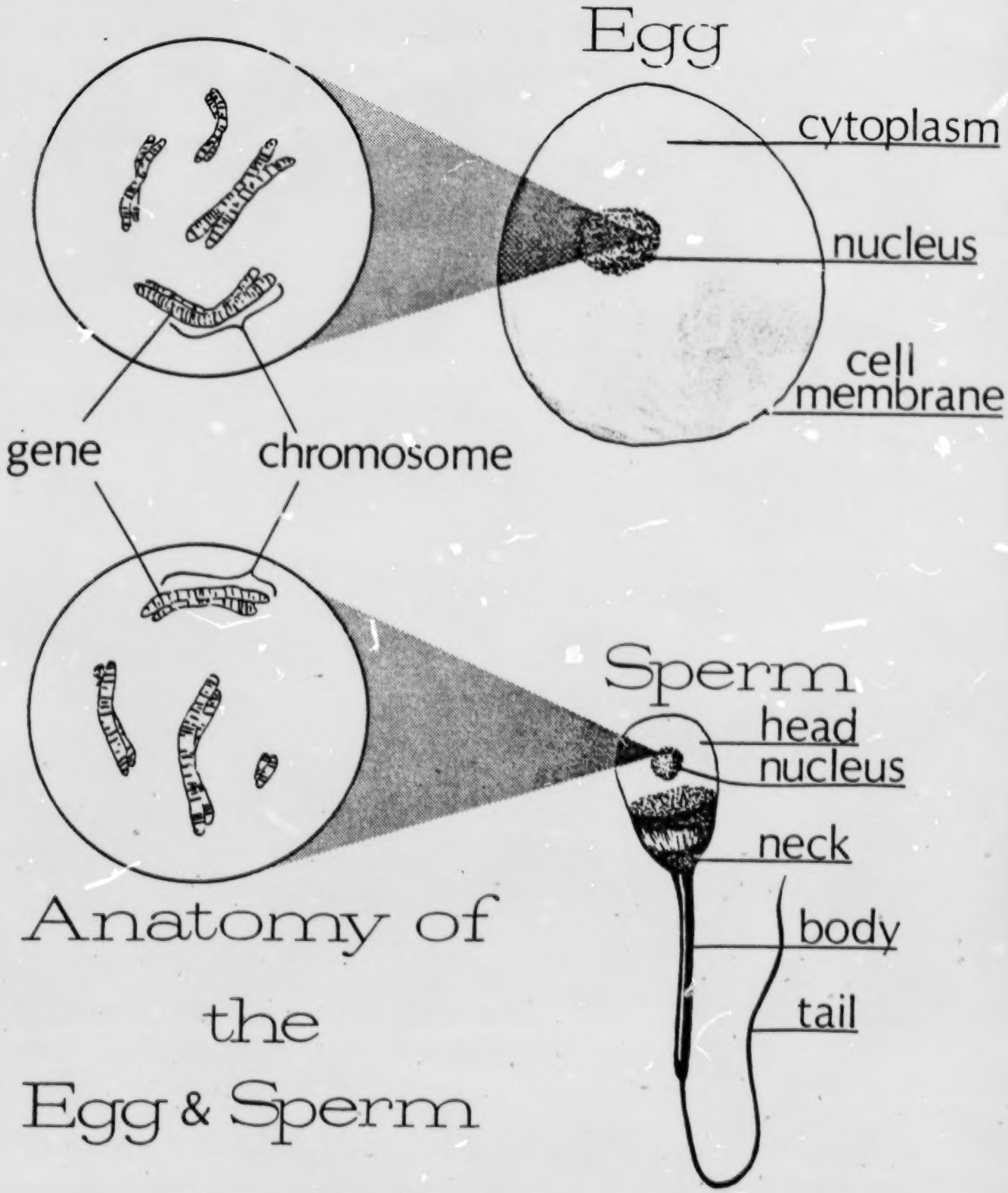
TM 2.2.1c

MALE REPRODUCTIVE SYSTEM



TM 2.2.1d

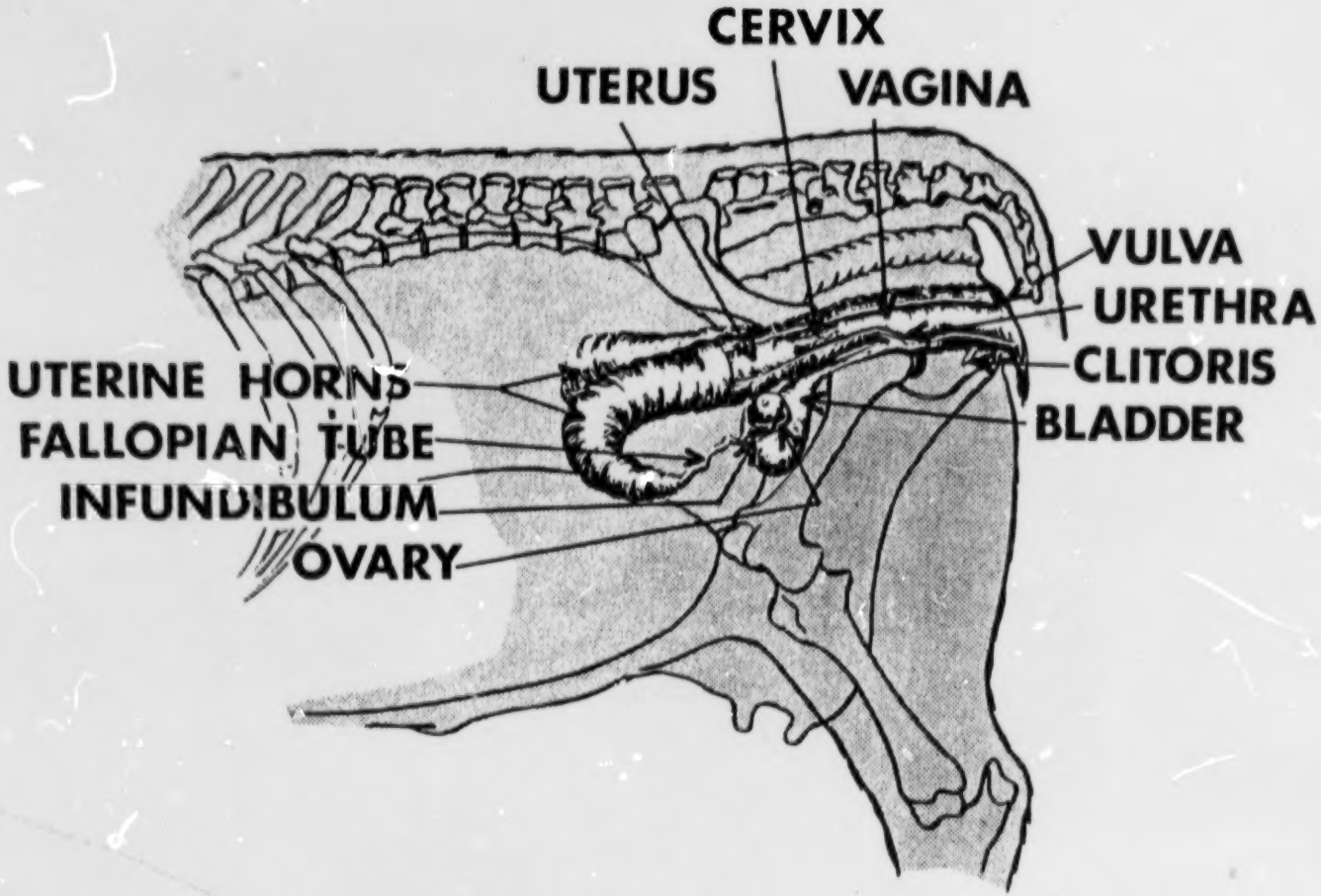
Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.



Anatomy of the Egg & Sperm

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

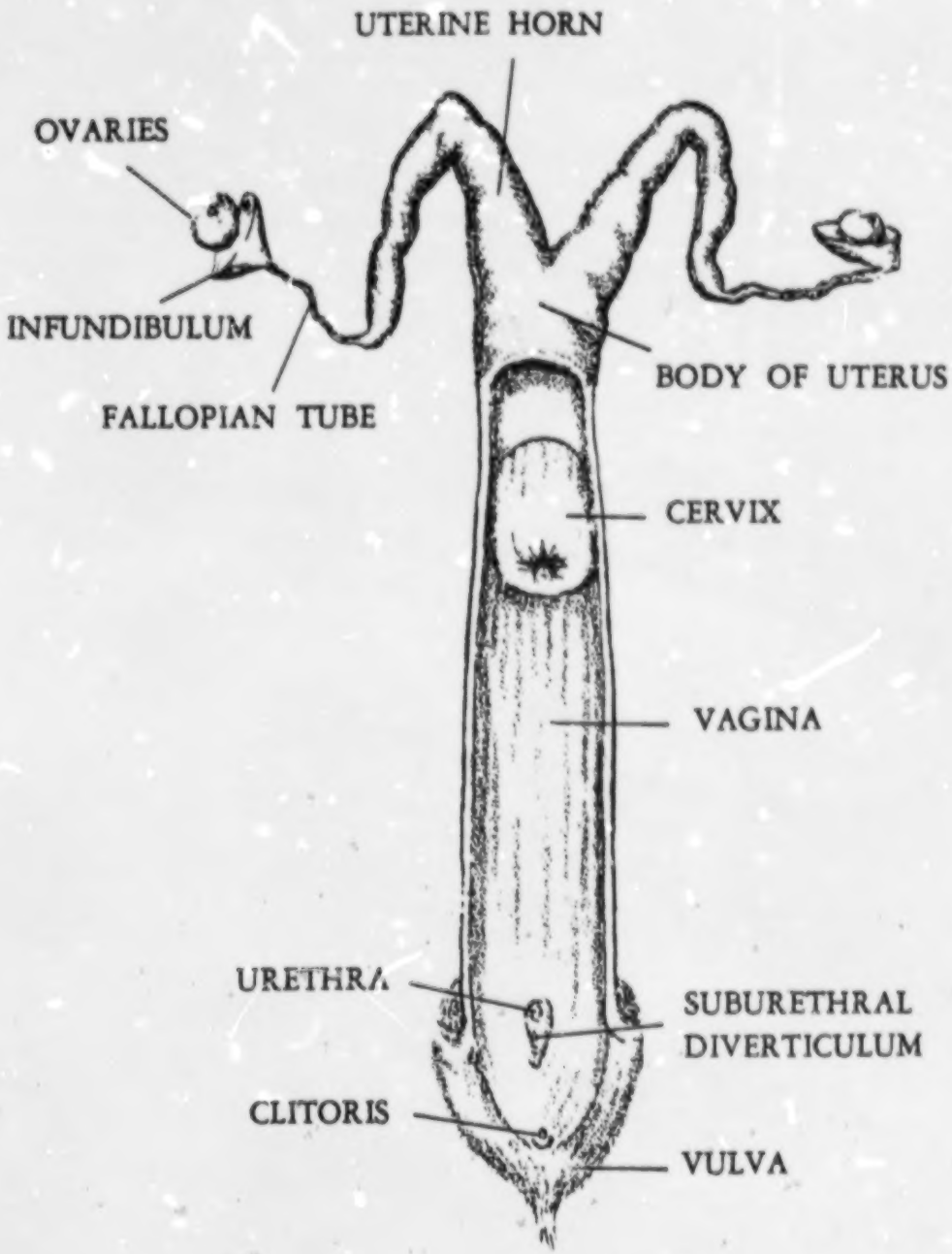
FEMALE REPRODUCTIVE SYSTEM



TM 2.2.1f

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

FEMALE REPRODUCTIVE TRACT
(top view)



Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

THE REPRODUCTION CYCLE IN FARM ANIMALS

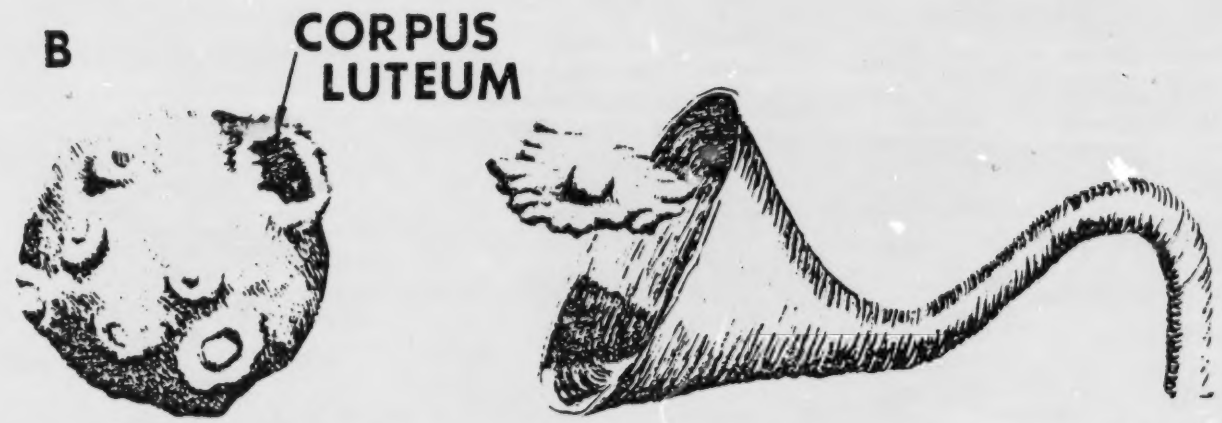
Species	Length of Estrus Cycle (days)		Length of Estrus		Usual Time of Ovulation	Length of Gestation (days)		Age at Puberty (months)
	av.	range	av.	range		av.	range	
mare	21	10-37	5-6 days	1-14 days	24-48 hrs. before end of estrus	336	310-350	10-12
cow	19-21	16-24	16-20 hrs.	8-30 hrs.	10-14 hrs. after end of estrus	281	274-291	8-12
ewe	16	14-20	30 hrs.	20-42 hrs	1 hr. before end of estrus	150	140-160	4-8
sow	21	18-24	1-5 days	1-5 days	18-60 hrs. after estrus begins	112	111-115	5-7

TM 2.2.1b

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

OVULATION

OVARY (DURING HEAT)



OVARY (NOT IN HEAT)

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

FERTILIZATION IN CATTLE

1.

egg passing through infundibulum into fallopian tube

sperm deposited through cervix, migrating through uteran horn into fallopian tube

2.

union of sperm and egg and migration of zygote to uterus

3.

attachment of zygote to wall of uteran horn

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

3. REPRODUCTIVE PROCESS

3.1 Performance Objective

Given a written check-out activity concerning the reproductive process, students will complete the activity with 80 percent accuracy.

3.2 Teaching-Learning Activities

a. This section on the reproductive process can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Use a biology teacher, veterinarian, or other knowledgeable person as a resource person.

c. Make and use transparencies and/or handouts from the transparency masters found under supplementary materials.

d. Have students work sample genetics problems.

3.2.1 Identify common parts of an animal cell. (See transparency master 3.2.1a.)

a. All living things are made up of millions of tiny structural units called cells. Some cells are so small that if laid side by side, it would take 250,000 of them to measure an inch. Animal life starts from a single, fertilized cell.

b. A cell is composed of a cell wall and protoplasm, and protoplasm consists of a nucleus and cytoplasm. The nucleus contains chromatin which forms bodies called chromosomes. The chromosomes carry minute cells called genes which determine the hereditary characteristics of the organism and are transmitted to the offspring from the parents. All animals of the same species have the same number of chromosomes and all animals have millions of genes. It is because of the millions of genes and possible combinations of these genes that no two animals are exactly alike.

3.2.2 Recognize the steps in cell division in growth (mitosis). (See transparency master 3.2.2a.)

A cell divides into two cells; then these two divide into four cells, and so on. The division of cells is called mitosis.

3.2.3 Explain the maturation process (meiosis). (See transparency master 3.2.3a.)

Before the male and female germ-cells unite, they go through a process called maturation, a process where the chromosomes in both

the male and female germ-cells are reduced to one-half of the original number. The maturation process in the male and female germ-cell are different. Only one in four of the female germ-cells are productive, while all of the male germ-cells will reproduce after uniting with an egg.

3.2.4 Compare chromosome numbers of different farm animals.

a. The number of chromosomes found in the cell of man and common animals are as follows:

Man-46	Horse-60
Swine-38	Goat-60
Cattle-60	Mouse-40
Sheep-54	Rat-42
Chicken-78	

b. Growth in animals is largely due to an increase in the number of cells rather than cell size. As cells divide, the animal increases in size (grows).

3.2.5 Describe how simple dominant and recessive body characteristics are inherited. (See transparency masters 3.2.4a, 3.2.4b, and 3.2.4c.)

a. Sex of an animal is determined by a single pair of chromosomes at the time of fertilization. In all animals but poultry, the female has, in addition to the regular chromosomes, two sex chromosomes, designated by the letters XX. In the male, only one sex chromosome (X) is present, and the other is designated as Y.

(1) After maturation one-half of the sperms and all of the eggs carry an X chromosome. The other one-half of the sperms carry a Y chromosome.
(2) If in fertilization, a sperm carrying an X chromosome unites with an egg, the offspring will be a female (XX). If the sperm carrying a Y chromosome unites with an egg, the offspring will be a male (XY).

b. In poultry the male carries the two sex chromosomes, while the female carries only one.

c. The polled or horned condition in cattle illustrates a dominant and recessive characteristic. The polled condition is dominant over the horned condition. There are two genes for this characteristic since genes in body cells always occur in pairs. One gene is inherited from the sire and the other gene from the dam.

(1) Since the polled condition is dominant, it will be designated with a (P). Having horns is recessive, so it will be designated with a (p).

(2) Since genes always occur in pairs (one coming from each parent), there may be three possible arrangements of genes in beef cattle in regard to this characteristic:

PP -- Animal is polled and all reproductive cells will carry the P gene (for polled condition).
P; -- Animal is polled. Polled is dominant over horned, and thus the P gene hides or covers up the effect of the p gene. However, half of this animal's reproductive cells will carry the p gene (for the horned condition) and half will carry the P gene (for the polled condition).
pp -- Animal is horned and all reproductive cells will carry the p gene (for the horned condition).

What would we expect if we crossed a homozygous for polled bull (PP) with a horned cow (pp)?

-- What would the offspring's physical appearance or phenotype as it relates to horned or polled be like? All offspring would be polled.

-- What would the genotype be for these offspring? The genotype for all offspring will be Pp.

What would we expect if we crossed a heterozygous for polled bull (Pp) with a heterozygous for polled cow (Pp)?

-- What would be the offspring's physical appearance or phenotype as related to horned or polled? Three-fourths would be polled and one-fourth would be horned.

-- What would constitute its gene make-up or genotype? One-fourth would be PP, one-half would be Pp and one-fourth would be pp.

3.2.6 Describe how multiple dominant and recessive characteristics are inherited. (See transparency masters 3.2.6a, 3.2.6b, and 3.2.6c.)

a. In multiple dominant and recessive characteristics, the same principle applies as with a single dominant and recessive characteristic. The different possible combinations of genes, however, are greatly increased.

(1) With two pairs of genes (two characteristics), there are 16 possible combinations of genes in the new animals. (Some of these combinations are the same genetically. This varies with the genetic make-up of the parents. When both parents have heterozygous genes for both characteristics, there are genetically nine different combinations.)
(2) With three pairs of genes (three characteristics), there are 64 possible combinations of genes in the new animals. (Genetically there are 27 different possible combinations of genes when the genes of each parent are heterozygous for all three characteristics.)

b. The physical appearance of animals having multiple dominant and recessive characteristics is not as varied as is their genetic composition. (In simple dominant and recessive characteristics, there are just two possible physical appearances--either the dominant characteristic or the recessive characteristic will show. However, there are three different possible genetic arrangements in this case.)

(1) With two dominant and two recessive characteristics, there are four possible different physical appearances. (But there are nine possible different genetic combinations of genes.)

Example:

P is polled (dominant) W is white faced (dominant)
p is horned (recessive) w is colored faced (recessive)

If we crossed a heterozygous for polled white face bull (PpWw) with a heterozygous for polled white face cow (PpWw), what would we expect? There are 16 genotypes possible. Nine genotypes would be polled white face, three would be polled colored face, three would be horned white face, while one would be horned colored face.

(2) With three dominant and three recessive characteristics, there are eight possible different physical appearances. (In this case there are, however, 27 different combinations of genes.)

c. A characteristic can be the result of incomplete dominance. Roan color in Shorthorn cattle is the result of <u>incomplete dominance</u> of red and white. In this case, capital letters are used to designate each gene (R = red; W = white).

What would we expect if we crossed a red bull (RR) with a white cow (WW)? All offspring would be roan.

What would we expect if we crossed a white bull (WW) with a roan cow (RW)? One-half would be white and one-half roan.

3.3 <u>Supplementary Materials</u>

References: See books listed under List of Resources at back of unit.

Transparency Masters:
1. 3.2.1a, "Parts of an Animal Cell."
2. 3.2.2a, "Steps in Cell Division in Growth."
3. 3.2.3a, "Maturation Process (Meiosis)."
4. 3.2.4a, "Sex Determination in Animals."

5. 3.2.4b, "An Example of Gene Pairs Dividing."

6. 3.2.4c, "A Diagram for Determining Probable Results From a Dominant and Recessive Characteristic."

7. 3.2.6a, "A Cross With Two Characteristics."

8. 3.2.6b, "Color Determination in Shorthorns."

9. 3.2.6c, "Traits and Their Level of Heritability."

3.4 Check-Out Activities

Provide the students with the following exercise:

1. Protoplasm consists of a nucleus and cytoplasm. T F

2. All animals have less than 10,000 genes. T F

3. The division of cells is called _____.

4. Another name for maturation or the process where both the male and female germ-cells are reduced to one-half is also called _____.

5. How many chromosomes do cattle have? _____

6. Growth in animals is due largely to cell growth. T F

7. Sex of an animal is determined by a single pair of chromosomes at the time of fertilization. T F

8. Recessive conditions are designated with a capital letter. T F

9. Genes in body cells always occur in pairs. T F

10. All possible different genetic combinations produce different physical appearances. T F

11. What would you expect the offspring to look like if you crossed a homozygous for polled heterozygous for white face bull (PPWw) with a heterozygous for polled, homozygous for white face cow (PpWW)?

12. Homozygous means unlike genes. T F

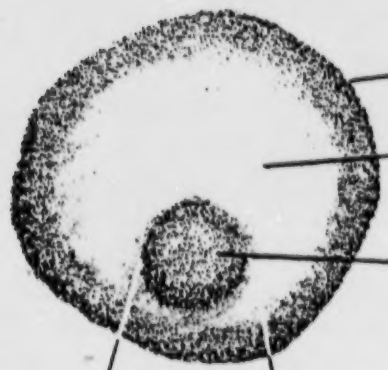
13. Phenotype refers to the physical appearance of an animal. T F

14. Genotype refers to the gene make-up of an animal. T F

ANSWERS:

1. True
2. False
3. Mitosis
4. Meiosis
5. 60
6. False
7. True
8. False
9. True
10. False
11. Polled and white face
12. False
13. True
14. True

PARTS OF AN ANIMAL CELL



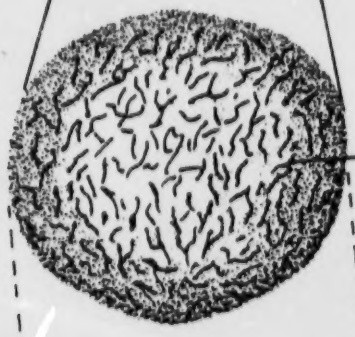
CELL WALL (MEMBRANE)

CYTOPLASM

NUCLEUS

PROTOPLASM

CELL



CHROMATIN

CHROMOSOMES

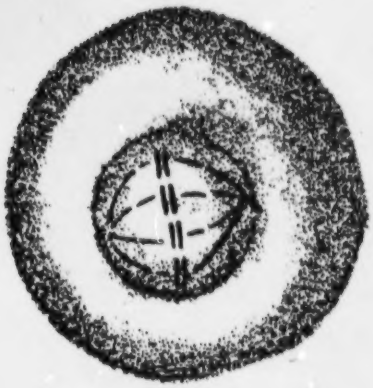
CELL NUCLEUS

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

STEPS IN CELL DIVISION IN GROWTH (MITOSIS)

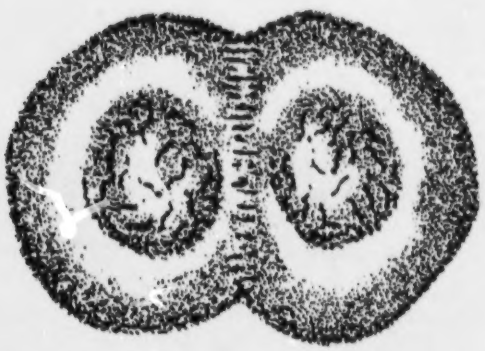
RESTING CELL

CHROMOSOMES FORMING

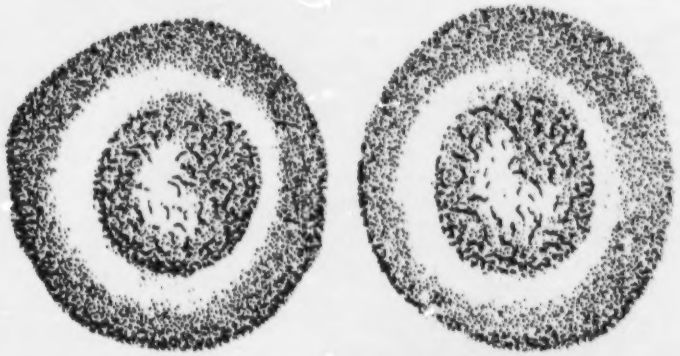


CHROMOSOMES DIVIDING

CHROMOSOMES AND NUCLEUS SEPARATING



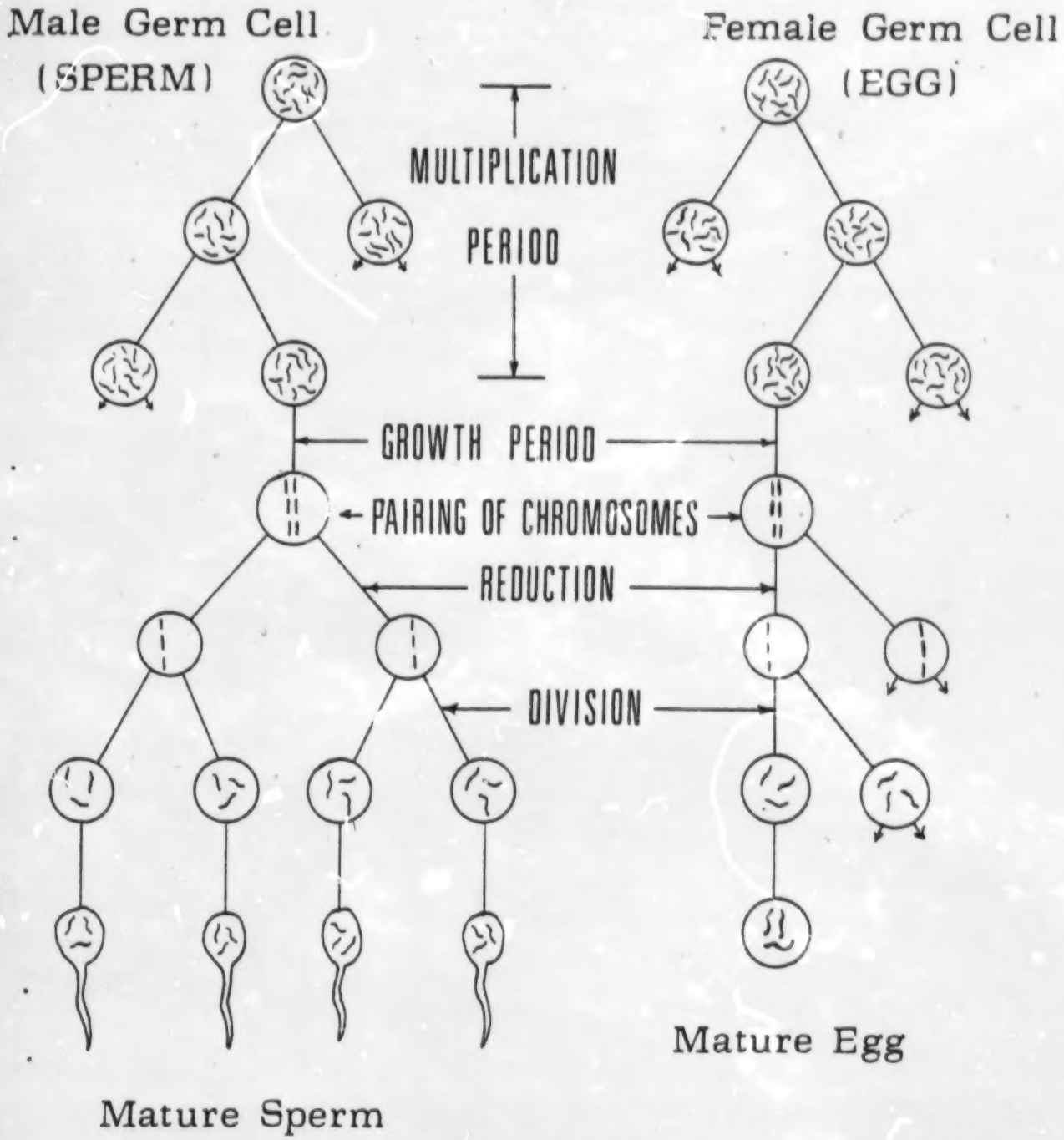
CELL DIVIDING



TWO CELLS FORMED

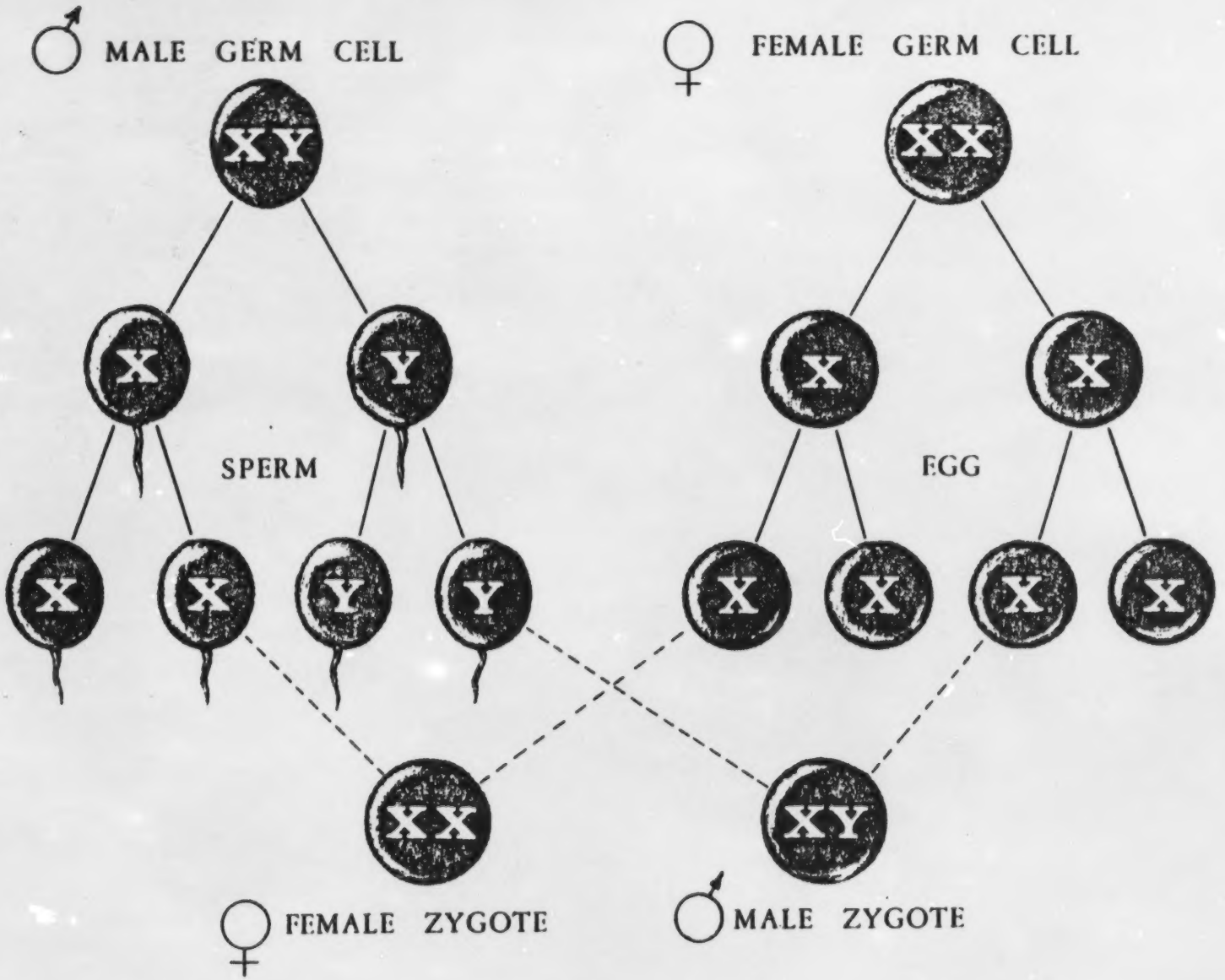
Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

MATURATION PROCESS (MEIOSIS)



Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

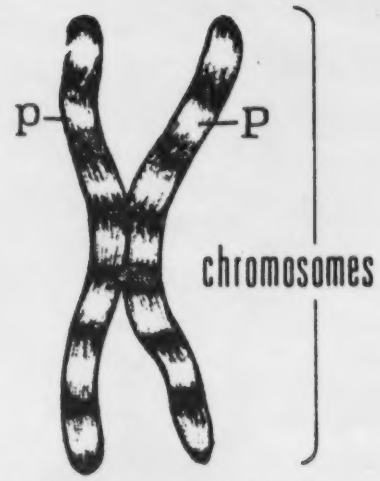
SEX DETERMINATION IN ANIMALS



TM 3.2.4a

Source: Lesson Plans for Vocational Agricuture Instructors, Texas A & M University.

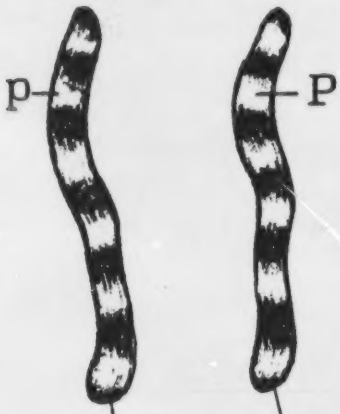
AN EXAMPLE OF GENE PAIRS DIVIDING



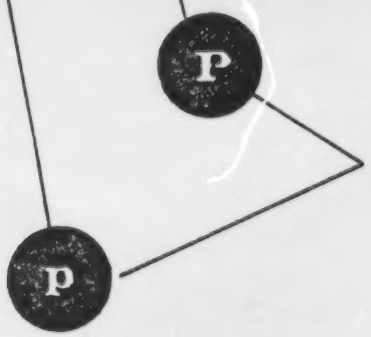
Genes and Chromosomes Paired

P GENE FOR POLLED TRAIT (DOMINANT)

p GENE FOR HORNED TRAIT (RECESSIVE)



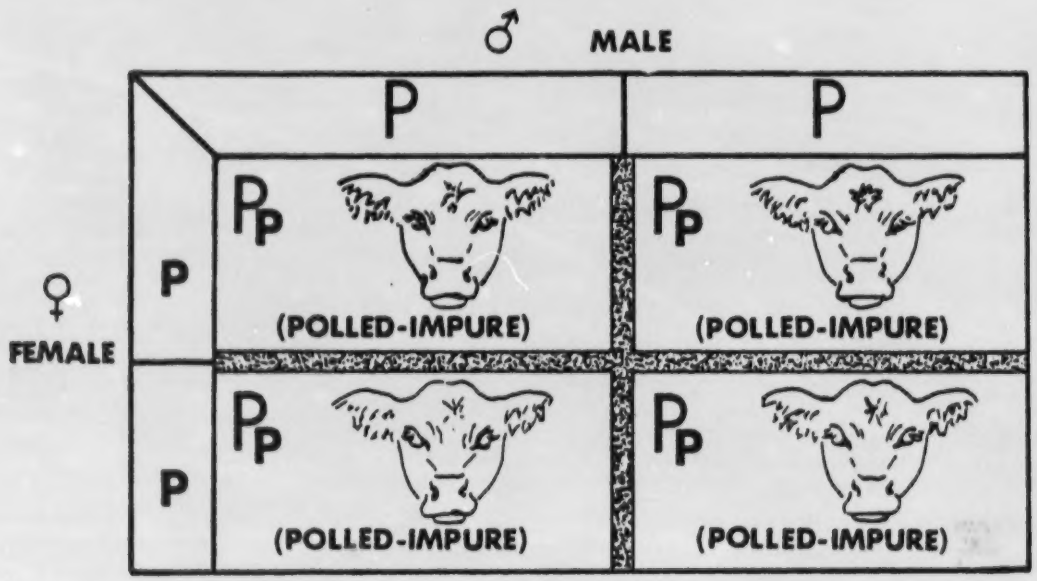
Genes and Chromosomes Dividing (MEIOSIS)

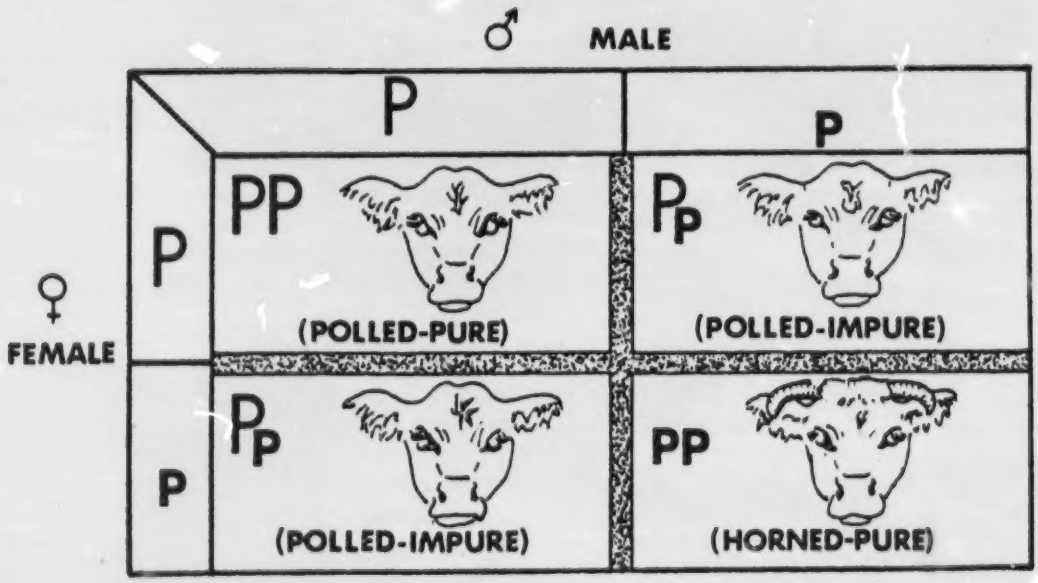


Gametes Formed Showing Genotype

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

A DIAGRAM FOR DETERMINING THE PROBABLE RESULTS FROM A DOMINANT AND RECESSIVE CHARACTERISTIC





Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

A CROSS WITH TWO CHARACTERISTICS

♂ MALE

♀ FEMALE

	PW	Pw	pW	pw
PW	☆ **PPWW** (POLLED, WHITEFACED)	☆ **PPWw** (POLLED, WHITEFACED)	☆ **PpWW** (POLLED, WHITEFACED)	☆ **PpWw** (POLLED, WHITEFACED)
Pw	☆ **PPWw** (POLLED, WHITEFACED)	★ **PPww** (POLLED, COLOREDFACED)	☆ **PpWw** (POLLED, WHITEFACED)	★ **Ppww** (POLLED, COLOREDFACED)
pW	☆ **PpWW** (POLLED, WHITEFACED)	☆ **PpWw** (POLLED, WHITEFACED)	✪ **ppWW** (HORNED, WHITEFACED)	✪ **ppWw** (HORNED, WHITEFACED)
pw	☆ **PpWw** (POLLED, WHITEFACED)	★ **Ppww** (POLLED, COLOREDFACED)	✪ **ppWw** (HORNED, WHITEFACED)	● **ppww** (HORNED, COLOREDFACED)

☆ — 9 POLLED, WHITEFACED

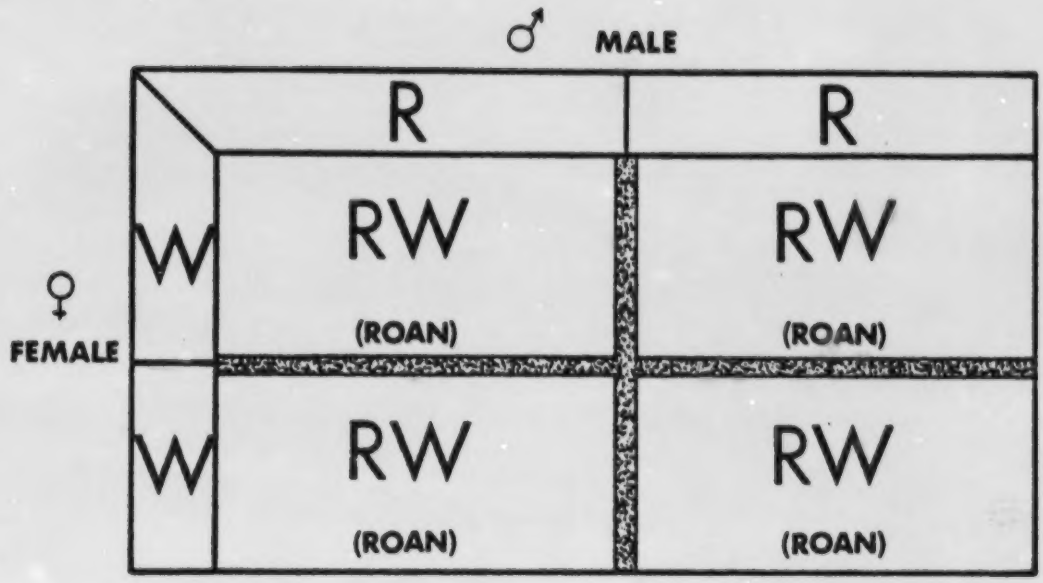
★ — 3 POLLED, COLOREDFACED

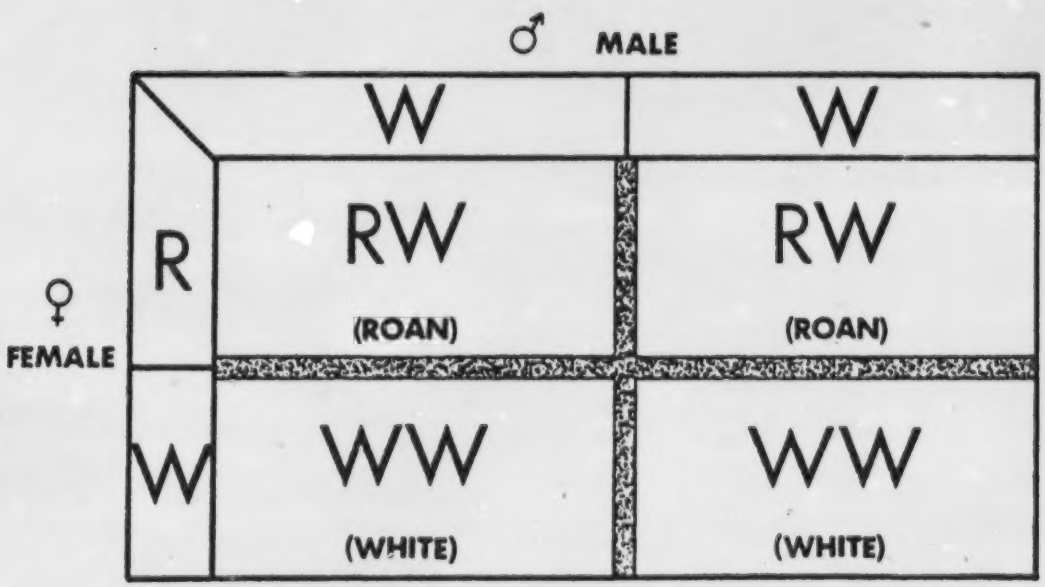
✪ — 3 HORNED, WHITEFACED

● — 1 HORNED, COLOREDFACED

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

COLOR DETERMINATION IN SHORTHORNS





Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

TRAITS AND THEIR LEVEL OF HERITABILITY

TRAIT	LEVEL OF HERITABILITY
REPRODUCTIVE PERFORMANCE	LOW to MODERATE
WEANING WEIGHT	MODERATE
COW MATERNAL ABILITY	MODERATE
FEEDLOT GAIN	MODERATE+
CARCASS GRADE	MODERATE+
FEED EFFICIENCY	MODERATE+
RIBEYE AREA	HIGH+
TENDERNESS	HIGH
FAT THICKNESS	MODERATE
CARCASS YIELD	MODERATE
YIELD OF RETAIL CUTS	MODERATE
CANCER EYE SUSCEPTIBILITY	MODERATE
EYE LID PIGMENTATION	HIGH

LOW=less than 30%

MODERATE=30-50% HIGH=greater than 50%

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

4.0 SIRE SELECTION

4.1 Performance Objective

Given a written check-out activity concerning sire selection, students will complete the activity with 80 percent accuracy.

4.2 Teaching-Learning Activities

a. This section on sire selection can best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Take the students on field trips to observe the characteristics desired when selecting a sire.

c. Use good livestock breeders or extension personnel as resource persons.

d. Use members or former members of the livestock judging team to help describe desired characteristics of good sires.

e. Make and use transparencies and/or handouts from the transparency masters found under supplementary materials.

4.2.1 Recognize the importance of the sire on production. (See transparency masters 4.2.1a, 4.2.1b, and 4.2.1c.)

a. The male (♂) determines half (50 percent) of the inherited capacity of any animal to produce.

b. In a herd of 20 cows, the bull (♂) will account for half (50 percent) of the inherited traits of all the calves produced, while in the same herd, each cow (♀) will contribute 2.5 percent of the inherited traits to all the calves produced.

c. Because the influence of the male is so widespread on the farm, it is important to own or secure the services of superior males. If production is to be improved, male animals must be genetically superior to the average of the females on the farm.

4.2.2 Analyze the pedigrees of purebred sires.

Look for indications that the sire is capable of improving production. Consider the merits of the sire's parents, grandparents, etc. It is from these animals that a sire receives his inherent capacity.

4.2.3 Identify ways of securing the services of purebred sires.

We can secure the services from superior sires:

a. By purchasing superior purebred animals.

b. By using the services of superior males through artificial breeding. (See transparency master 4.2.3a.)

c. Through production testing--using services of males of proven ability to transmit desired characteristics.

4.3 Supplementary Materials

References: See books listed under List of Resources at back of unit.

Transparency Masters:

1. 4.2.1a, "Upgrading by Using Purebred Sires."
2. 4.2.1b, "Upgrading by Using Purebred Sires" (Continued).
3. 4.2.1c, "Upgrading by Using Purebred Sires" (Continued).
4. 4.2.3a, "Why Breed Artificially?"
5. 4.2.3b, "Limitations of Artificial Insemination."

4.4 Check-Out Activities

Provide the students with the following exercise:

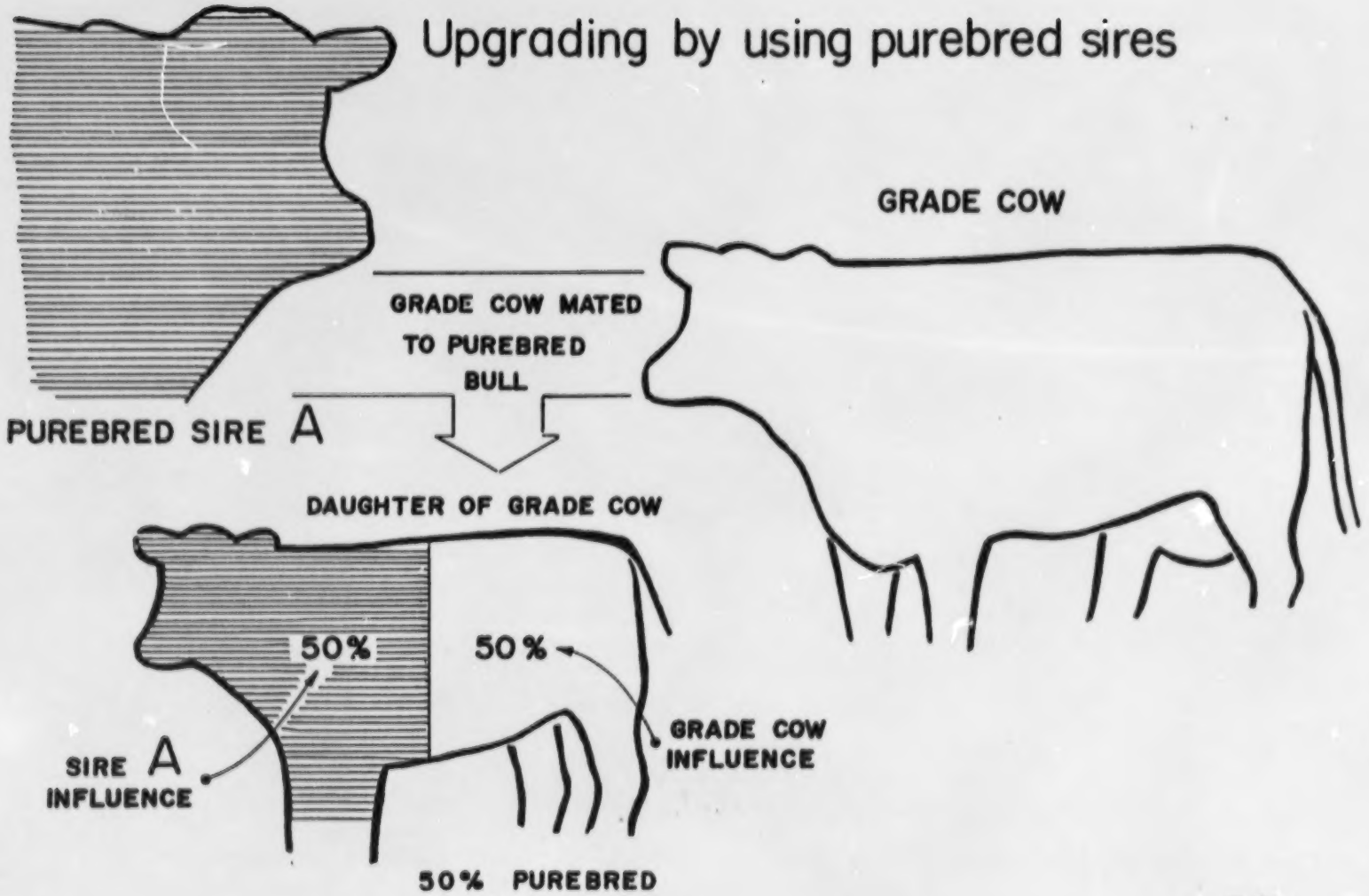
1. The male (♂) is more important genetically in a herd as far as production is concerned than the female (♀). T F
2. The female is of more importance genetically to her offspring than the male. T F
3. In a herd of 10 cows, the male accounts for 50 percent of the inherited traits. T F
4. In a herd of 10 cows, each cow accounts for 50 percent of the inherited traits of her offspring. T F
5. In a herd of 10 cows, each cow accounts for 10 percent of the inherited traits as far as the total herd is concerned. T F
6. The ancestory of a sire is not important to consider before buying. T F

7. A good way of securing the services of superior sires is through production testing. T F

ANSWERS:

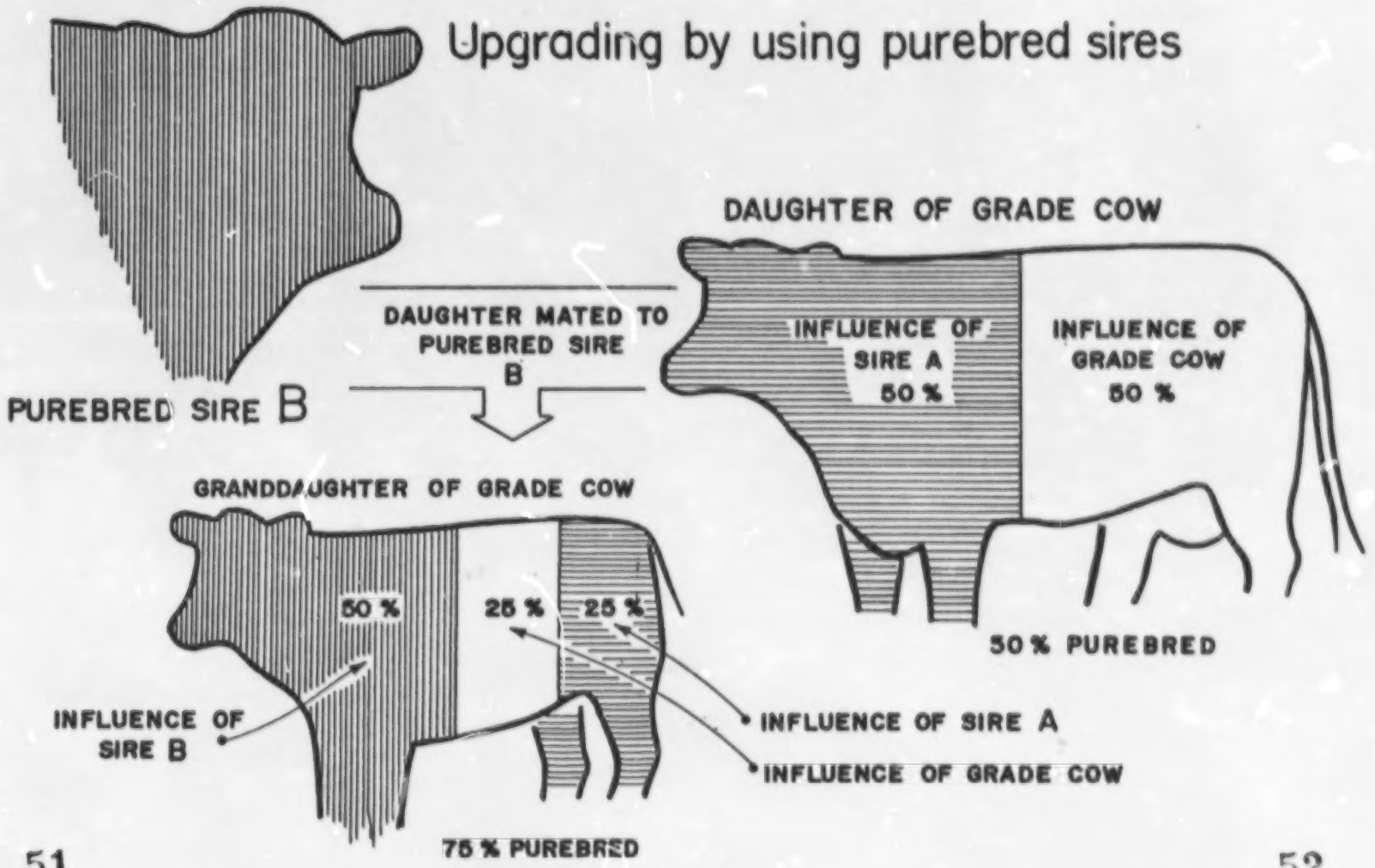
1. True
2. False
3. True
4. True
5. False
6. False
7. True

Upgrading by using purebred sires



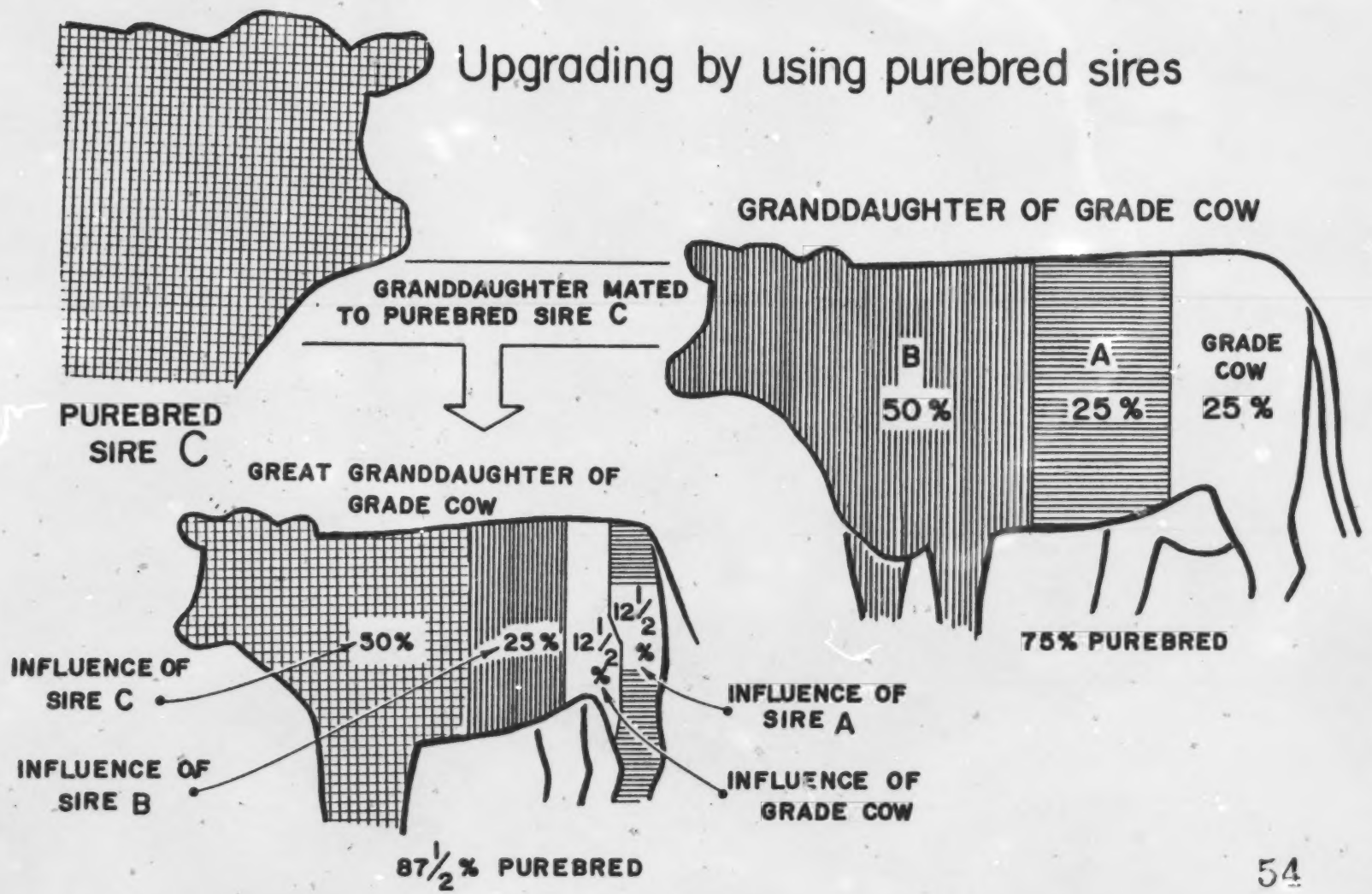
TM 4.2.1a

SIRES – Continued



TM 4.2.1b

SIRES – Continued



TM 4.2.1c

WHY BREED ARTIFICIALLY ?

A. MAXIMUM USE OF OUTSTANDING SIRES

B. GREATLY INCREASED UNIFORMITY

C. POSSIBLE TO OVERCOME CERTAIN PHYSICAL HANDICAPS TO MATING

D. LESSENS SIRE COST

E. ALLEVIATES DANGER AND BOTHER OF KEEPING A SIRE

F. REDUCES THE COST AND DELAYS OF USING INFERTILE SIRES

G. BETTER HEALTH PROTECTION

H. IMPROVED HERD RECORDS

I. INCREASES PROFITS

J. INCREASES PRIDE OF OWNERSHIP

TM 4.2.3a

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

LIMITATIONS OF ARTIFICIAL INSEMINATION

A. REQUIRES SKILLED TECHNICIAN

B. MUST CONFORM TO PHYSIOLOGICAL PRINCIPLES

C. MAY RESTRICT THE SIRE MARKET

D. MAY INCREASE THE SPREAD OF DISEASE

E. MAY BE SUBJECT TO CERTAIN ABUSES

F. MAY ACCENTUATE THE DAMAGE OF A POOR SIRE

G. CONSIDERABLE CAPITAL AND COMPETENT MANAGERIAL ABILITY ARE NECESSARY TO INITIATE AND OPERATE AN ARTIFICIAL BREEDING ORGANIZATION

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

5.0 BREEDING SYSTEMS

5.1 Performance Objective

Given a written check-out activity concerning breeding systems, students will complete the activity with 80 percent accuracy.

5.2 Teaching-Learning Activities

a. This section on breeding systems may best be taught using the problem-solving procedure. Prepare appropriate problems for class use.

b. Take field trips to observe various breeding systems in operation.

c. Use good livestock breeders or extension personnel as resource persons.

d. Make and use transparencies and/or handouts from the transparency masters found under Supplementary Materials.

5.2.1 Identify the different systems of breeding.

a. There are two systems of breeding livestock--inbreeding and outbreeding. Inbreeding is the mating of animals more closely related than average of the group from which they came, while outbreeding is the mating of animals less closely related than average of the group from which they came. (See transparency masters 5.2.1a and 5.2.1b.)

b. Matings between half-sibs and full-sibs, as well as parent offspring matings, are examples of inbreeding. The primary effect of inbreeding is to increase homozygosity. Increased homozygosity brings to light undesirable recessive genes, tends to lower phenotypic merit on the average, separates a breed into strains or families, and increases prepotency of an animal. Inbreeding does not create undesirable recessive genes, but increases their expression due to homozygosity. (See transparency master 5.2.1c.)

c. Outcrossing, crossbreeding, and grading-up are forms of outbreeding. Outbreeding is the opposite of inbreeding and the genetic results are opposite. Outbreeding increases heterozygosity and, as a result, tends to destroy family or strain formation, increases average phenotypic merit, and reduces prepotency of an animal. (See transparency masters 5.2.1d and 5.2.1e.)

5.2.2 Utilize inbreeding to best advantage.

a. Critical evaluation of an animal (usually a sire) before building a breeding program around this animal is accomplished by breeding the animal to a number of its offsprings. When an animal is mated to 35 of its offsprings and all the progency is normal-appearing (with respect to undesirable recessive genes), you can be reasonably sure that the animal is not a carrier of undesirable recessive genes.

b. Concentrated use of a genetically-superior animal (usually a sire) is accomplished through use of a milder form of inbreeding known as linebreeding. Where linebreeding is utilized, the primary objective of the mating system is to maintain a high degree of relationship between animals in a pedigree but with a rather low level of inbreeding.

c. Inbreeding can be utilized to develop genetically different lines for later crossing to take advantage of heterosis concept. This is the method by which hybrid corn is produced, but the method has not been utilized to any great extent for livestock production.

d. Normally a decline in average phenotypic merit for various traits can be expected, on the average, when a high level of inbreeding is practiced; however, results realized from inbreeding within a specific herd are a function of genetic merit of animals involved in the breeding program. If the animals carry undesirable recessive genes, these undesirable recessive genes would be expected to show up due to increased homozygosity as the inbreeding progresses, and average phenotypic merit would be expected to decline. This is especially true for fertility traits; however, this is not to imply that all inbreeding will lead to disastrous results. As was emphasized for linebreeding, all inbreeding does not result in detrimental results, especially when the inbreeding program is directed towards a genetically superior individual. It is suggested that inbreeding be utilized more widely in herds of relative high genetic merit which are devoted primarily to production of breeding stock for the livestock industry.

5.2.3 Utilize outbreeding to best advantage.

a. Outcrossing refers to the mating of unrelated animals within a particular breed. The idea with this form of outbreeding is to mate those animals within a breed that are unrelated but considered to be genetically superior for certain traits. This is the mating procedure followed by many purebred breeders and tends to bring about immediate improvement for certain traits, especially those that express high heritability values. A typical example of use of outcrossing is the situation where a purebred swine breeder wishes to reduce average backfat thickness within the herd. Since backfat thickness in swine is a trait which expresses a relatively high heritability value,

average backfat thickness within a herd would be expected to decline through use of purebred boars that express low probe backfat thickness measurements.

b. Crossbreeding refers to mating of animals from different breeds. Crossbreeding can be utilized: (1) to combine desirable characteristics of different breeds, (2) take advantage of the concept of heterosis and (3) form a large genetic base for development of a new breed.

Using crossbreeding in combining desirable characteristics of different breeds is a good way to improve animals. Examples of combining desirable characteristics of different breeds involves crossing of blackface rams (growth rate, feed efficiency, carcass merit) with ewes that are predominately of Rambouillet (vigorous, hardy, gregarious) breeding, crossing of Brahman (insect and heat tolerance) and British (growth rate, feed efficiency, carcass merit) breeds, and crossing of hogs of Hampshire (growth rate, feed efficiency, carcass merit) and Yorkshire (prolificacy) breeds.

The second reason for crossbreeding is to take advantage of the concept of heterosis of which there are three types--individual, maternal and paternal. Heterosis refers to the superiority of crossbred animals over straightbred animals with respect to a particular trait and can be either positive or negative depending upon the trait.

c. Crossbreeding systems can also use straightbred bulls. The five most common crossbreeding systems which utilize straightbred bulls are: two-breed-crossing, three-breed-crossing (three-breed-terminal cross), criss-crossing (two-breed-rotation), three-breed-rotation, and four-breed-rotation. The two-breed-cross system only takes advantage of heterosis expressed by the crossbred calf; whereas, the other four systems take advantage of heterosis expressed by the crossbred calf and crossbred cow. Of the five crossbreeding systems, the three-breed-terminal cross system yields the maximum heterosis.

d. Grading-up is a mating procedure whereby sires of a given breed are mated to a particular kind or breed of female and their female offspring generation after generation. The grading-up terminology has been used in the past to refer to situations where purebred sires were mated to so-called "native" or "nondescript" females in an effort to develop a population resembling the breed from which purebred sires came.

The first-generation offspring carry 50 percent of the inheritance of purebred and, depending upon genetic superiority of original females, the first-generation female offspring can usually be expected to represent a considerable improvement over their dams in terms of overall productivity. The second-generation results in offspring with 75 percent of the

inheritance of the purebreed, and in subsequent generations, the proportion of inheritance remaining from the original females is halved with each generation of grading-up. With six crosses of purebred sires, grade animals carry 98.4 percent of the hereditary material of the purebreed. At this point, the grades are considered to be essentially purebreds. In the later generations, grading-up is very similar to outcrossing, whereas, in early generations, grading-up is similar to crossbreeding. Thus, productivity is usually greatest during the early generations because of heterosis expression; however, heterosis would be expected to decline with advancing generations of the grading-up process. Consequently, overall productivity of the graded-up herd would be expected to regress toward level of genetic merit of herds from which purebred sires used in grading-up process were acquired.

Because of certain import restrictions on breeding cattle, grading-up is being utilized currently to a large extent in the U. S. cattle industry as a means of producing populations of high-grade "exotic" cattle. For example, Simmental semen is being used initially to inseminate Hereford cows with the idea of developing purebred or high-grade Simmentals. In this case where females of Hereford breed serve as the female base, the resulting calves will express a color pattern similar to the Simmental. In addition to the Simmental, other "exotic" breeds of cattle are being developed by this grading-up mating procedure.

5.3 Supplementary Materials

References: 1. Beef Production, Pages 63-71.

2. See books listed under List of Resources at back of unit.

Transparency Masters:

1. 5.2.1a, "A Comparison of Several Traits of Purebred and Crossbred Cattle."
2. 5.2.1b, "A Comparison of Traits of Purebred and Crossbred Cattle."
3. 5.2.1c, "Amount of Inbreeding From Various Matings."
4. 5.2.1d, "Crossbreeding (Three-Breed Rotational Cross Method)."
5. 5.2.1e, "Crossbreeding (Criss-Cross Method)."

5.4 Check-Out Activities

Provide the students with the following exercise:

1. There are two general systems of breeding livestock. T F

2. Crossbreeding results in heterosis expression. T F

3. Inbreeding causes undesirable recessive genes. T F

4. The breeding of two unrelated animals is known as linebreeding. T F

5. Inbreeding normally results in a decline of average phenotypic merit. T F

6. Outcrossing refers to the mating of unrelated animals within a particular breed. T F

7. Crossbreeding refers to mating of animals of different breeds. T F

8. The two-breed-cross system yields maximum heterosis. T F

9. Grading-up is commonly used to produce high-grade "exotic" cattle. T F

ANSWERS:

1. True
2. True
3. False
4. False
5. True
6. True
7. True
8. False
9. True

A COMPARISON OF SEVERAL TRAITS OF PUREBRED AND CROSSBRED CATTLE

	BREED OR CROSS OF DAM AND SIRE				
	H×H	B×B	F₁×H	F₁×B	SECONDCROSS×SG
% PREGNANT	89.3	78.6	91.7	95.7	71.4
% CALVED	82.1	71.4	86.4	91.3	71.4
% WEANED	78.6	42.9	70.8	86.9	71.4

FIGURE 2.

BREED OR CROSS OF COW	MILK YIELD, Lb.*	PERCENT ADVANTAGE OVER			
		H	B	H&B	SECONDCROSS
HEREFORD	7.4				
BRAHMAN	7.6				
AVE. OF H&B	7.5				
SECONDCROSS (½A×¼B×¼H)	12.8	73	68	71	
F_1 (½B×½H)	13.4	81	76	79	5
AVERAGE	13.1			75	

*Uncorrected for age of cow.

H - HEREFORD A - ANGUS B - BRAHMAN
SG - SANTA GERTRUDIS

TM 5.2.1a

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

A COMPARISON OF TRAITS OF PUREBRED AND CROSSBRED CATTLE

MATING INVOLVED SIRE×DAM	PERCENT LOST		
	CONCEPTION TO BIRTH*	BIRTH TO WEANING**	TOTAL
B×B	3.0	20.5	23.5
H×H	2.1	2.2	4.3
B×H	0.0	4.0	4.0
H×B	0.0	4.7	4.7
B×(½B×½H)	0.0	0.0	0.0
H×(½B×½H)	0.0	0.0	0.0
A×(½B×½H)	0.9	0.9	1.8
A×(½A×¼B×¼H)	0.0	0.0	0.0

*=Calves lost as percent of cows pregnant
**=Calves lost as percent of cows that calved

H - HEREFORD A - ANGUS B - BRAHMAN

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

TM 5.2.1b

AMOUNT OF INBREEDING FROM VARIOUS MATINGS

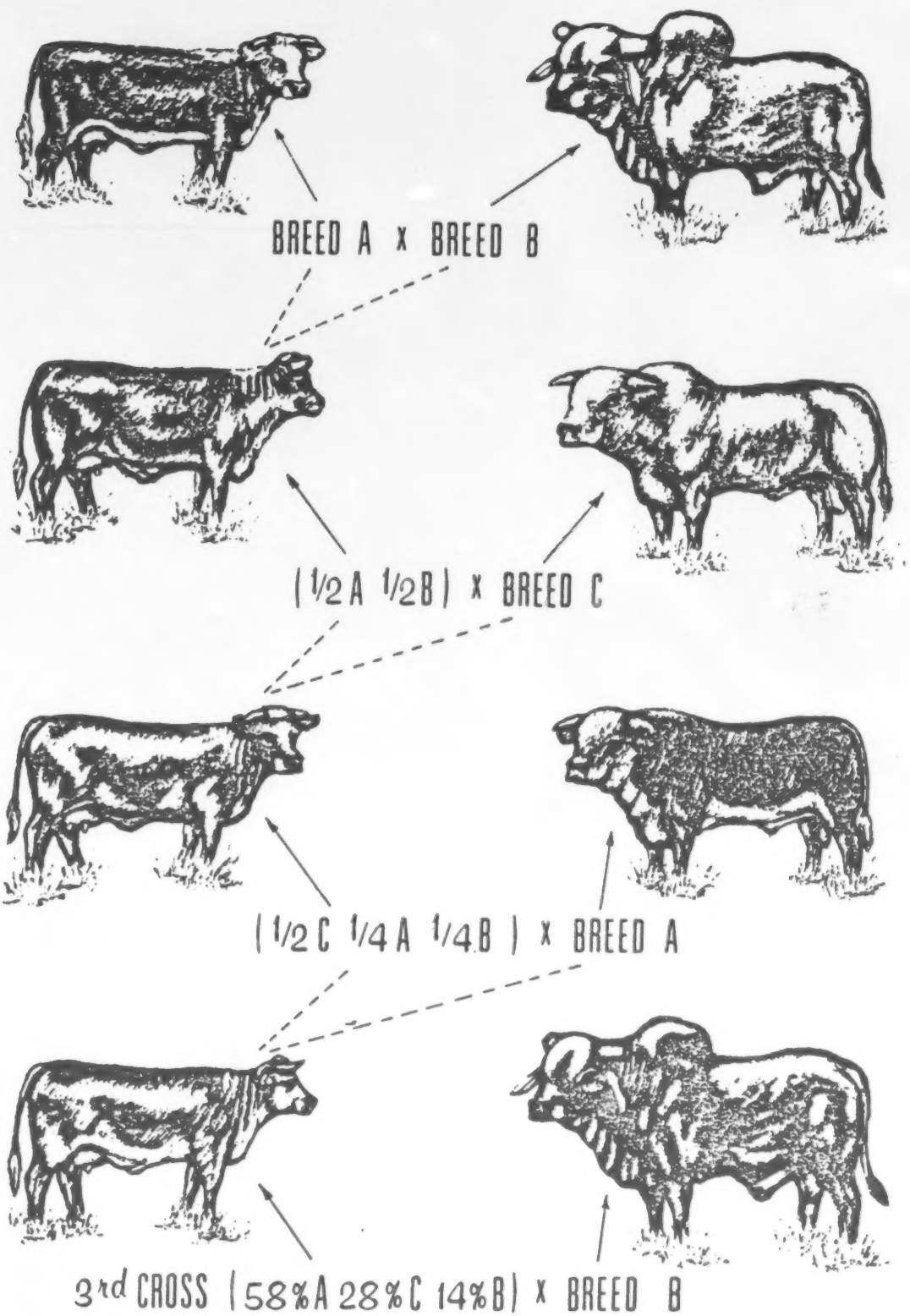
MATING	OFFSPRING
BROTHER×SISTER PARENT×OFFSPRING	25% INBRED
½ BROTHER×SISTER UNCLE×NIECE NEPHEW×AUNT	12.5% INBRED
½ UNCLE×NIECE NEPHEW×½ AUNT	6.25% INBRED
COUSIN×COUSIN	3.125% INBRED

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

CROSSBREEDING

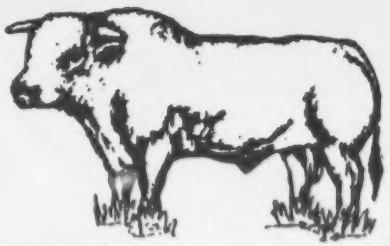
TM 5.2.1d

(Three-Breed Rotational Cross Method)

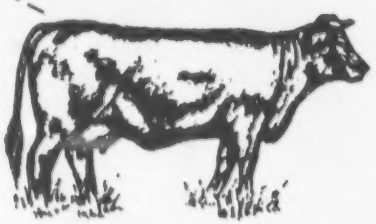


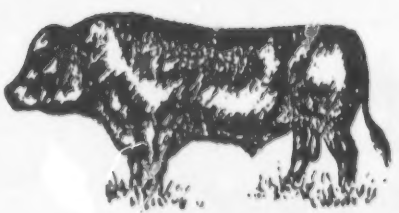
Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

CROSSBREEDING (Criss-Cross Method)



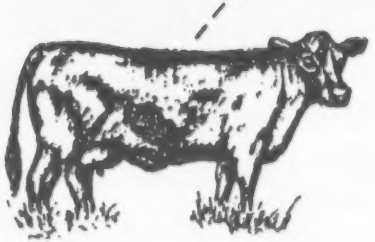
BREED A x BREED B

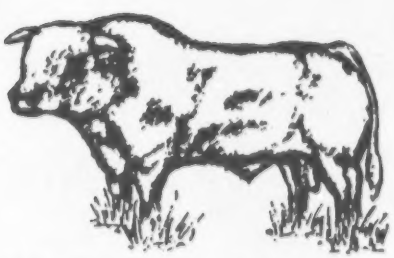




(1/2A 1/2B) x BREED A

(3/4A 1/4B) x BREED B





(1/2A 1/2B) x BREED B

(1/4A 3/4B) x BREED A

TM 5.2.1e

Source: Lesson Plans for Vocational Agriculture Instructors, Texas A & M University.

LIST OF RESOURCES

Books

Animal Science, 7th ed., M. E. Ensminger. The Interstate, Danville, Illinois, 1977. 1047 pages.

Beef Cattle Science, 5th ed., M. E. Ensminger. The Interstate, Danville, Illinois, 1976. 1556 pages.

Beef Production, 3rd. ed., Ronald V. Diggins and Clarence E. Bundy. Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1971. 276 pages.

Dairy Cattle Science, 1st ed., M. E. Ensminger. The Interstate, Danville, Illinois, 1971. 524 pages.

Dairy Production, 4th ed., Ronald V. Diggins, Clarence E. Bundy, and Virgil W. Christensen. Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1979. 326 pages.

Horses and Horsemanship, 5th ed., M. E. Ensminger. The Interstate, Danville, Illinois, 1977. 537 pages.

Livestock and Poultry Production, 4th ed., Clarence E. Bundy, Ronald V. Diggins, and Virgil W. Christensen. Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1975. 630 pages.

Livestock Production, 2nd ed., H. H. Cole, W. H. Freeman & Co., San Francisco, California, 1966. 827 pages.

Poultry Science, 1st ed., M. E. Ensminger. The Interstate, Danville, Illinois, 1971. 276 pages.

Progressive Farmer, Beef Cattle Book: A Working Guide for Cattlemen, Tom Curl. Oxmoore House, Inc., Birmingham, Alabama, 1978. 128 pages.

Sheep and Wool Science, 4th ed., M. E. Ensminger. The Interstate, Danville, Illinois, 1970. 948 pages.

The Stockman's Handbook, 5th ed., M. E. Ensminger. The Interstate, Danville, Illinois, 1978. 1192 pages.

Swine Production, 4th ed., Clarence E. Bundy, Ronald V. Diggins, and Virgil W. Christensen. Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1976. 374 pages.

Swine Science, 4th ed., M. E. Ensminger. The Interstate, Danville, Illinois, 1970. 881 pages.

The Science of Animal Husbandry, James Blakely and David Bade. Reston Publishing Co., Reston, Va., 1976. 416 pages.

Working in Animal Science, Paul Peterson, Allen C. Christensen, and Edward A. Nelson. Gregg Division, McGraw-Hill Book Company, 1978. 248 pages.

Kentucky Cooperative Extension Publications*

A Controlled, Seasonal Cattle Breeding Program, ASC-58, Clyde M. Triplett, 1978. 4 pages.

Applied Genetics, ASC-54, F. A. Thrift and R. L. BreDahl, 1977. 4 pages.

Crossbreeding Programs for Commercial Pork Production: Pork Industry Handbook, ASC-75, Charles J. Christians and Rodger K. Johnson, 1979. 6 pages.

Determining Pregnancy in Cattle, ASC-61, A. M. Sorensen, Jr. and J. R. Beverly, 1978. 10 pages.

Economics of Reproductive Performance and Breeding Herd Management: Pork Industry Handbook, ASC-82, Emmett Stevermer, Wayne Singleton, and Al Mueller. 4 pages.

Guidelines for Choosing Replacement Females: Pork Industry Handbook, ASC-68, William T. Ahlschwede and Robert H. Grummer, 1979. 4 pages.

Which Bull is the Best Semen Buy? Kentucky Dairy News, Roger McCraw, Ken Butcher, and Ken Olson, July 31, 1979. 15 pages.

Reproductive Tract Anatomy and Physiology of the Cow, ASC-60, Ron Parker, 1979. 4 pages.

Transparency Masters

"Animal Genetics and Breeding" (53 frames, includes transparencies), Vocational Agriculture Service, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801

"Artificial Insemination" (17 transparency masters), Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California 93407

"Genetics" (9 plates and 7 overlays), Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California 93407

*These are available free of charge from your county cooperative extension office or can be ordered in quantity (up to one per each two students in your largest class) through the Department of Vocational Education, University of Kentucky, Room 43 Dickey Hall, Lexington, Ky., 40506.